

Scope of Claims

1. A fibre-reinforced plastic structure with a hollow section which is characterized in that

5 (A) it is a fibre-reinforced plastic structure with a hollow section which is provided with at least one opening and with a main body portion having in the interior a cavity of maximum width greater than the maximum width of the
10 aforesaid opening(s),

(B) the aforesaid main body portion is composed of fibre-reinforced plastic where reinforcing fibre has been impregnated with synthetic resin and, furthermore,

15 (C) the aforesaid main body portion has a solid of non-revolution shape where the interior maximum width (F) of the cavity is at least 0.5 m and the ratio (F/f) of the interior maximum width (F) of the cavity to the maximum width (f) of
20 the aforesaid opening(s) lies in the range 1.1 to 500, and

(D) furthermore, the aforesaid main body portion is formed as an integral construction in which its totality substantially has no regions which are joined.

25 2. A fibre-reinforced plastic structure with a hollow section according to Claim 1 which is characterized in that, at the inner circumferential face of the aforesaid main body portion, there is a projecting rib which projects in the
30 radial direction thereof.

3. A fibre-reinforced plastic structure with a hollow section according to Claim 2 which is characterized in that

the aforesaid projecting rib has a frame structure with a core material present in the interior and, furthermore, with the periphery of the core material enveloped by a skin layer containing reinforcing fibre.

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4. A fibre-reinforced plastic structure with a hollow section according to any of Claims 1 to 3 which is characterized in that, in the fibre-reinforced plastic of the aforesaid main body portion, there are substantially no reinforcing fibres extending continuously over two or more laps in the circumferential direction.

5. A fibre-reinforced plastic structure with a hollow section according to any of Claims 1 to 4 which is characterized in that a closed space is formed in the main body portion.

6. A fibre-reinforced plastic structure with a hollow section according to Claim 5 which is characterized in that, as well as the section in the aforesaid circumferential direction forming a closed space, a portion formed as an integral construction substantially having no joined regions is positioned at the end or at a central region of the aforesaid main body portion.

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7. A fibre-reinforced plastic structure with a hollow section which is characterized in that

(A) it is composed of a plurality of moulded elements,

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(B) at least one of these moulded elements is a structure which is provided with at least one opening and with a main body portion having a cavity in the interior and,

furthermore, the section thereof has a solid of non-revolution shape,

(C) the aforesaid main body portion is composed of
5 fibre-reinforced plastic where the reinforcing fibre has been impregnated with synthetic resin and, furthermore,

10 (D) the aforesaid main body portion has in at least one location a portion forming a closed space in the circumferential direction section and which is formed as an integral construction substantially having no joined regions.

8. A fibre-reinforced plastic structure with a hollow section according to Claim 7 which is characterized in that
15 the aforesaid opening is positioned at an end portion of the structure comprising a plurality of moulded elements.

9. A fibre-reinforced plastic structure with a hollow section according to Claim 7 or Claim 8 which is
20 characterized in that, in the aforesaid structure, the interior maximum width (F) of the cavity is at least 0.51 m and the ratio (F/f) of the internal maximum width (F) of the cavity to the maximum width (f) of the aforesaid opening lies in the range 1.1 to 500.

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10. A fibre-reinforced plastic structure with a hollow section according to Claim 9 which is characterized in that
30 at the inner surface facing the cavity of the aforesaid structure, there is a rib projecting in the radial direction thereof.

11. A fibre-reinforced plastic structure with a hollow section according to Claim 10 which is characterized in that

the aforesaid projecting rib has a frame structure with a core material present in the interior and the periphery thereof enveloped by a skin layer containing reinforcing fibre.

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12. A fibre-reinforced plastic structure with a hollow section according to any of Claims 1 to 11 which is characterized in that the main body portion of the aforesaid structure is formed with a shell comprising aforesaid skin layer positioned on the outside and core material positioned on the inside.

13. A fibre-reinforced plastic structure with a hollow section according to Claim 12 which is characterized in that the aforesaid structure is formed with a shell where skin layer comprising fibre-reinforced plastic is further laminated on the inside of the aforesaid core material.

14. A fibre-reinforced plastic structure with a hollow section according to Claims 12 or 13 which is characterized in that the aforesaid core material has a rib which extends in the radial direction of the structure.

15. A fibre-reinforced plastic structure with a hollow section according to any of Claims 3 to 6 and 11 to 14 which is characterized in that the aforesaid core material comprises a foam.

16. A fibre-reinforced plastic structure with a hollow section according to any of Claims 3 to 6 and 11 to 15 which is characterized in that a groove is formed in the surface of the aforesaid core material.

17. A fibre-reinforced plastic structure with a hollow section according to any of Claims 1 to 16 which is characterized in that a liner is provided in at least one part of the inner face of the aforesaid main body portion.

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18. A fibre-reinforced plastic structure with a hollow section according to Claim 17 which is characterized in that the aforesaid liner has a plurality of concave grooves.

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19. A fibre-reinforced plastic structure with a hollow section according to any of Claims 1 to 18 which is characterized in that the aforesaid reinforcing fibre is at least one type from amongst carbon fibre, glass fibre, aramid fibre, high density polyethylene fibre and polyarylate fibre.

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20. A fibre-reinforced plastic structure with a hollow section according to any of Claims 1 to 19 which is characterized in that the aforesaid reinforcing fibre comprises carbon fibre tow, where one tow has a number of single filaments in the range 12,000 to 200,000.

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21. A fibre-reinforced plastic structure with a hollow section according to any of Claims 1 to 20 which is characterized in that the void content of the aforesaid main body portion lies within the range 2% and below, by volume.

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22. A fibre-reinforced plastic structure with a hollow section according to any of Claims 1 to 21 which is characterized in that the aforesaid synthetic resin is at least one type from amongst epoxy resins, unsaturated polyester resins, vinyl ester resins and phenolic resins.

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23. A fibre-reinforced plastic structure with a hollow section according to any of Claims 1 to 22 which is characterized in that a covering layer is integrally formed at the outer face of the main body portion.

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24. A fibre-reinforced plastic structure with a hollow section according to Claim 23 which is characterized in that the covering layer is a gel coat layer.

10 25. Transport modes characterized in that they have, as part thereof, a fibre-reinforced plastic structure with a hollow section according to any of Claims 1 to 24.

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15 26. A method for the production of a fibre-reinforced plastic structure with a hollow section, which is characterized in that it proceeds via at least the following stages in turn:

20 (A) An inner mould preparation stage in which an inner mould of cross-section having a non-circular sectional shape is positioned on a stand

25 (B) A substrate arrangement stage in which substrate comprising in part or in total reinforcing fibre is arranged at the surface of the aforesaid inner mould

30 (C) A pressure-reduction stage in which the top of the aforesaid substrate is covered with a bag and the interior pressure of said bag is reduced to below atmospheric pressure

(D) A synthetic resin impregnation stage in which synthetic resin is injected into the aforesaid reinforcing fibre and the interior of the substrate impregnated by

uniform diffusion of said resin in the reinforcing fibre substrate face direction

27. A method for the production of a fibre-reinforced plastic structure with a hollow section according to Claim 26 which is characterized in that the entire structure is also cured within the temperature range 50 to 200°C, and integral moulding effected.

28. A method for the production of a fibre-reinforced plastic structure with a hollow section, which is characterized in that it proceeds via at least the following stages in turn.

(A) An inner mould preparation stage where an inner mould of cross-section having a non-circular sectional shape is positioned on a stand

(B) A substrate arrangement stage in which substrate comprising in part or in total reinforcing fibre is arranged at the outer surface of the aforesaid inner mould

(C) An outer mould arrangement stage in which the outer periphery of the aforesaid reinforcing fibre arranged substrate is covered with an outer mould

(D) A pressure-reduction stage in which the pressure is reduced between the aforesaid outer mould and the inner mould

(E) A synthetic resin impregnation stage in which synthetic resin is injected into the aforesaid reinforcing fibre and the interior of the substrate impregnated by

uniform diffusion of the resin in the reinforcing fibre substrate face direction

29. A method for the production of a fibre-reinforced plastic structure with a hollow section according to Claim 28, which is characterized in that at least a part of the outer face of the inner mould is covered with a sheet-shaped covering material, and substrate comprising in part or in total reinforcing fibre is arranged on top thereof, after which the outer periphery is covered over with an outer mould, and the pressure between said outer mould and the inner mould then reduced and synthetic resin injected in a state with the aforesaid covering material caused to expand or move in the outer mould direction, so that said resin diffuses through the reinforcing fibre substrate in the face direction and, in this way, the reinforcing fibre substrate interior is impregnated with the resin.

30. A method for the production of a fibre-reinforced plastic structure with a hollow section according to any of Claims 26 to 29, which is characterized in that there is used a hollow inner mould in the inner mould arrangement stage (A).

31. A method for the production of a fibre-reinforced plastic structure with a hollow section according to Claims 28 or 29, which is characterized in that there is used an inner mould comprising an elastic material in the inner mould arrangement stage (A).

32. A method for the production of a fibre-reinforced plastic structure with a hollow section according to Claims 28, 29 or 31 which is characterized in that, in the aforesaid inner mould arrangement stage (A), the inner mould interior

is pressurized with a fluid and said inner mould made to expand in the outer mould direction.

33. A method for the production of a fibre-reinforced plastic structure with a hollow section according to Claim 32 which is characterized in that, in the aforesaid inner mould preparation stage (A), the fluid used for pressurizing the interior of the inner mould is compressed air and the applied pressure thereof lies within the range 0.049 to 0.98 MPa (0.5 to 10 kg/cm²G).

34. A method for the production of a fibre-reinforced plastic structure with a hollow section according to Claims 26 to 33 which is characterized in that, in the aforesaid inner mould preparation stage (A), there is employed an inner mould having resin channel grooves in the outer face and the synthetic resin is injected into the reinforcing fibre substrate from said grooves.

35. A method for the production of a fibre-reinforced plastic structure with a hollow section according to any of Claims 29 to 34 which is characterized in that, in aforesaid substrate arrangement stage (B), there is employed a resin diffusion medium which enables the resin to diffuse into the aforesaid covering material.

36. A method for the production of a fibre-reinforced plastic structure with a hollow section according to Claim 35 which is characterized in that there is used a reticulate material as the aforesaid resin diffusion medium.

37. A method for the production of a fibre-reinforced plastic structure with a hollow section according to any of

Claims 26 to 36 which is characterized in that there is used a plastic, a rubber material, a water-soluble polymer material or a wood material as the aforesaid inner mould.

5 38. A method for the production of a fibre-reinforced plastic structure with a hollow section according to any of Claims 26 to 37 which is characterized in that like aforesaid structures are mutually joined together by a local vacuum moulding method to form a single body.

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39. A method for the production of a fibre-reinforced plastic structure with a hollow section according to any of Claims 26 to 38 which is characterized in that, in the aforesaid substrate arrangement stage (B), when arranging the substrate comprising reinforcing fibre there is used, between substrates or between the substrate and inner mould a substrate retainer which secures the substrate.

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40. A method for the production of a fibre-reinforced plastic structure with a hollow section according to any of Claims 26 to 39 which is characterized in that there is used an inner mould which is moulded as a hollow body by means of the blow moulding method.

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41. A method for the production of a fibre-reinforced plastic structure with a hollow section according to any of Claims 26 to 40, which is characterized in that it has an inner mould removal stage in which the inner mould is removed from the integrally-moulded structure.

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42. A method for the production of a fibre-reinforced plastic structure with a hollow section according to any of Claims 26 to 40 which is characterized in that the inner

mould is integrally coupled to the structure and left within the integrally-moulded structure.

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5 43. A method for the production of a plurality {sic} of fibre-reinforced plastic structures with hollow sections which is characterized in that, it is a method for the production of a fibre-reinforced plastic structure composed of a plurality of moulded elements, at least one of which moulded elements has a section which constitutes a solid of non-revolution shape and which is provided with at least one opening and with a main body portion having a cavity in the interior,

15 and when joining together the aforesaid moulded elements, reinforcing fibre is arranged spanning the region of join between the moulded elements, and the regions of join are locally covered with bags from above the reinforcing fibre, after which the pressure inside the bags is reduced and resin injected, and impregnation effected, so that the moulded
20 elements are mutually connected together.